CURRENCY FORWARD AND FUTURES MARKETS

A currency forward or futures contract entails an obligation to trade an underlying currency at a specified rate of exchange, which is determined today, on a specified future delivery date. The specified rate of exchange is known as the forward price or futures price. Future delivery dates may be nearby or deferred in time. If the contract calls for the purchase of the underlying foreign exchange, the trader is said to hold a long position in the contract. A short position represents an obligation to sell currency in the future.

Currency forward and futures contracts are derivative securities. They are "written on" the underlying foreign exchange, and the forward and futures prices depend critically on the underlying currency's spot rate of exchange. Currency forward and futures contracts offer investors and multinational corporations (MNCs) the ability to better manage their exchange exposure. These contracts can also be employed for speculative purposes or for future price discovery.

In this chapter we analyze currency forward and futures contracts and markets. We highlight the important differences between these closely related instruments. We also provide illustrations of how these contracts can be used to estimate subsequent spot rates, to speculate on currency movements, and to immunize against unanticipated changes in rates of exchange.

MARKETS

The currency forward market offers private contracts that are tailored to the specific needs of customers. Large banks and private currency brokers network and trade electronically to meet the customer's needs. For instance, an MNC may require a forward contract for two or more years. It can obtain such a contract through direct negotiations with its bank. Often the negotiating is done over the telephone, and the bank may
require compensating balances or lines of credit to insure the MNC's obligation. These currency forward contracts often are valued at $1 million or more to facilitate the transactions of large MNCs.

Forward contracting in currencies (and other underlying assets) has existed for centuries. Currency futures contracts represent an institutionalized form of currency forward contracting. Currency futures are traded on an organized market, which is a physical trading floor where standardized or listed contracts are traded face to face. The first listed currency futures contracts began trading on the International Monetary Market (IMM) division of the Chicago Mercantile Exchange on 16 May 1972. This was about the time that the floating exchange rate system emerged. Also, the advent of currency futures trading represented the first-ever trading of financial futures contracts. Before 1972, only agricultural and metallurgical futures were traded on organized exchanges. Today financial futures trading, including that on stock indices and treasury securities as well as currency, represents the majority of all futures trading.

The IMM is the largest trader of listed currency futures contracts. Exhibit 12.1 presents contract sizes and other details for the currency futures contracts traded on the IMM. Exhibit 12.2 presents total and relative trading volumes for these contracts for the calendar year 1989.

Listed futures contracts on foreign exchange traded on the IMM and other organized futures exchanges may not appeal to MNCs desiring longer-term and otherwise less standardized contracts. Instead, currency futures appeal more to individual traders and speculators and smaller firms unable to transact in the currency forward market.

Exhibit 12.3 provides a comprehensive comparison of the currency forward and IMM currency futures markets. Highlighting this exhibit are the following differences:

- Contract sizes and delivery dates are standardized for currency futures but are negotiated and tailored for currency forward contracts.
- Qualified public speculation is encouraged for futures but not for forwards.
- Currency futures trading entails posting a small security deposit.
- Currency forward contracts are accessible only to large creditworthy customers who deal in foreign trade.
- The majority of forward contracts are settled via reversing trades (discussed later) such that delivery never occurs.

Currency Futures Trading

Besides the IMM, currency futures contracts are traded on the Philadelphia Board of Trade, the London International Financial Futures Exchange, the Singapore International Monetary Exchange, the Sydney Futures Exchange, and several other organized exchanges worldwide. At each of these exchanges trading occurs in areas called pits. Traders in the pits offer to buy or sell through a system of open outcry or, often, by using sophisticated hand signals.

These traders may be members of the exchange who trade for their own accounts, typically called locals. Locals attempt to profit from their expertise in forecasting future spot exchange rates. Exchange members hold seats in the exchange, which is often organized as a not-for-profit association of its members. These memberships (seats) can be traded. A recent price commanded for a full seat on the Chicago Mercantile Exchange was $490,000 (4 May 1990).

Traders in the pits may also be representatives of trading firms (e.g., Merrill Lynch) that act as commission brokers, trading for their clients.
Such clients may be speculators, or hedgers seeking to immunize against adverse exchange rate movements. Some commission brokers trade for their own accounts as well. When traders in the pits trade for themselves and for others as commission brokers, we have what is known as dual trading. Currently such dual trading is criticized by many who feel that the trader somehow gains priority or favorable treatment to his own trading at the expense of outside clients. Such favorable treatment is known as frontrunning.

To illustrate a trade, assume that you (the client or principal) want to undertake a long position in the June British pound (BP) futures contract traded on the IMM. You are willing to assume the long position at market, meaning that you are seeking the best currently available price. The process begins with a phone call to your agent (account executive or broker), who must trade through an exchange member, typically a commission broker whose seat is financed by the agent’s trading firm. Your agent places the order with the commission broker, who executes the trade in the BP futures pit in return for a commission fee. Once the trade is executed, the commission broker confirms the trade with your agent, who then notifies you of the completed transaction and the futures price. You must then deposit an initial margin with a member firm of the clearinghouse (discussed later) by the start of trade the next morning. Typically, your broker or account executive handles this process, withdrawing funds from your established account.

The commission broker may have transacted in the pit with another commission broker who represented another public client. Alternately, he may have transacted with a local. Locals trade for their own accounts, buying contracts at a bid price, and selling contracts at a higher ask price. Locals are sometimes called scalpers, day traders, or position traders, depending on their trading behavior. Scalpers trade actively, holding their position for no more than a few minutes. They attempt to profit from volume trading and provide market liquidity. Day traders hold comparatively longer-term positions, but less than a full trading session. They attempt to profit on price movement but do not wish to assume the risk of holding longer-term positions. Position traders assume contract positions ranging from overnight to weekly or monthly periods.

### Types of Orders

Besides placing a market order, a public currency futures trader can place any of the following order types:

- **A limit order**, which stipulates a specific price at which you will contract. A limit order can be good only for a trading session (a day order), or until cancelled (an open order).
- **A fill-or-kill order**, which instructs the commission broker to fill an order immediately at a specified price. The order is cancelled if it cannot be transacted quickly.
- **An all-or-none order**, which allows the commission broker to fill part of the order at one specified price, and the remainder at another price.
- **An on-the-open or on-the-close order**, which represents orders to trade within a few minutes of opening or closing, respectively.
- **A stop order**, which triggers a reversing trade when prices hit a prescribed limit. Stop orders are used to protect against losses on existing positions.

### Transaction Costs

Transaction costs in currency futures markets are very small, especially for exchange members. Currently it costs locals about 24 cents per futures contract traded. Of course, public traders incur other costs. The following transaction costs are realized from futures trading:
Floor trading and clearing fees. These are the small fees charged by the exchange and its associated clearinghouse (discussed later). If a trade is executed through a commission broker, these fees are built into the broker's commission. Locals pay the fees directly.

Commissions. A commission broker charges a commission to transact a public order. This commission is paid at the order's inception and covers both the opening and reversing trades.

Bid-ask spreads. Locals simultaneously quote bid and ask prices. The bid-ask spread represents a transaction cost when effecting a trade with a local. The spread represents the cost of obtaining trading immediacy, since locals offer the public trading liquidity. A bid-ask spread is typically equal to the value of the contract's minimum price fluctuation, called a tick.

Delivery costs. A trader who holds a position until delivery is exposed to delivery costs. However, as previously noted, the overwhelming majority of currency futures contracts never entail actual delivery of the underlying foreign exchange.

Taxes
Determining the tax consequences of currency futures trading can be complex, especially when spreads (discussed later) are involved. Following are a few generally applicable tax guides:

Marking to the market. At the end of the calendar year, every futures contract is marked to the market so that any unrealized gains or losses are treated, for tax purposes, as though they were actually realized during the tax year.

Gains. The realized and unrealized gains from currency futures trading are taxed at the ordinary personal income tax rate.

Losses. The realized and unrealized losses are deductible by offsetting them against any other investment gains. Losses exceeding gains by up to $3,000 can be deducted against ordinary income.

Commissions. In general, brokerage commissions are tax deductible.

Price Quotes
Chapter 4 offered an exhibit indicating various currency forward prices. Exhibit 12.4 presents settlement prices for currency futures contracts traded on the IMM on 16 November 1988. Presented are the day's high, low, and settlement prices, as well as other information such as each contract's daily volume and current open interest, the number of contracts outstanding. For example, the settlement futures price for Canadian dollars, December 1988 delivery, was $0.8115/CD, up $0.0027/CD from the previous day's settlement. Open interest in all CD futures was 17,370 contracts.

All organized futures exchanges report their settlement prices in a similar manner. The reported prices are called settlement prices rather than closing prices, although in most cases the two prices are nearly the same. If volume in a particular contract was very thin (e.g., in a deferred contract), a settlement committee would determine a representative price to publish. This representative price is established by observing price changes that day for the more active (nearby) contract, and extrapolating to determine a rational price change for the inactive (deferred) contract.

Clearinghouses
A central part of any organized futures exchange is its clearinghouse, which guarantees contract performance to all market participants. The clearinghouse guarantees performance by breaking down every futures contract into two distinct contracts: one contract between the buyer (i.e., long position) and the clearinghouse acting as the seller, and one contract between the seller (i.e., short position) and the clearinghouse acting as a buyer. All traders have obligations to the clearinghouse, but not to each other. Also, the two traders need only be concerned with the reliability of the clearinghouse. However, clearinghouses have never defaulted on a contract. To do so would tear down the confidence of the market and ultimately the market itself.

Since the clearinghouse can match its long and short positions perfectly, it is said to be perfectly hedged. That is, its net position in all futures contracts is zero. The clearinghouse merely acts as an intermediary or dealer that facilitates trade and liquidity, and is exposed to little risk. The clearinghouse may be part of the futures exchange or, often, is incorporated separately. The clearinghouse charges a small transaction fee for its role.

Margins
Currency futures traders represent a source of credit risk to the clearinghouse. For instance, the long futures trader may have insufficient funds to purchase the underlying foreign exchange. To cover the risk, the
trader is required to post margin, usually with a member firm of the clearinghouse. This margin often is a cash deposit, but a bank letter of credit or liquid securities can be used. For instance, U.S. Treasury bills can be posted to cover at least part of the initial margin.

The initial margin varies from market to market. Exhibit 12.5 presents current margin requirements for the major currency futures contracts traded on the IMM. These are the margin requirements for pure speculators. Requirements for hedgers are typically lower. The initial margin is returned upon completion of the contract and, if securities are posted, the interest earned is paid to the trader.

### Daily Resettlement

The initial margin represents a small fraction of the underlying currency's total value. This is attributable to a procedure known as daily resettlement. Daily resettlement, or marking to the market, is a futures market requirement that traders realize losses daily.

1. Consider a specific example of daily resettlement using a British pound futures contract with futures price $1.25/£ and one month until expiration. Assume that the contract settles today at $1.22, down $0.03/£ from yesterday's settlement price. Since there are 25,000 pounds per contract traded on the IMM (see Exhibit 12.1), this represents a one-day loss of $750 ($0.03 x 25,000) to the long futures trader. At the end of the trading day, the $750 is deducted from the trader's margin deposited with the member firm. Then there is a margin call; that is, the trader must replenish the margin in order to resume the contract the next day. This is daily resettlement; the contract is now said to be marked to the market.

The trader may not need to replenish the entire $750. In general, the trader must deposit funds to restore a maintenance margin. This maintenance margin often is about 75% of the initial margin. From Exhibit 12.5, for BP futures the initial margin is $2,000 but the maintenance margin is just $1,500. Here the long futures trader must deposit only $250 [($1,500 - ($2,000 - $750))] in order to resume trading. This $250 deposit is known as the variation margin, which is usually paid in cash. To smooth this daily process, the broker or account executive typically has permission to draw the required deposit from the trader's established account.

The daily resettlement procedure facilitates low margin requirements. Because losses are realized daily, the margin has to cover only one-day price changes, which are typically very small. The overall effect of the daily resettlement procedure is to create a safer futures market, allowing less creditworthy investors to participate. To see this, compare the currency futures and forward markets with respect to the timing of cash flows. In the forward market no daily resettlement exists, so the only cash flow that can occur is at delivery of the forward contract. Clearly, big price fluctuations can occur over the life of forward contracts. For instance, recall that currency forward contracts often have maturities of two or more years. Exchange rates can change dramatically over such long periods. Consequently, the potential risk exhibited by forward contracts is greater than that exhibited by futures contracts, where daily resettlement ensures small price changes between cash flows. As a result, only very large and creditworthy MNCs can participate in the currency forward market. Exhibit 12.6 provides another, self-contained illustration of the daily resettlement process.
Reversing Trades

In the currency forward market, the vast majority of contracts are settled by actual delivery of the underlying foreign exchange. In contrast, nearly all currency futures contracts are settled by reversing trades such that delivery never occurs. A reversing trade effectively makes a trader's net futures position equal to zero. For instance, suppose a trader had agreed to buy British pounds for delivery next December. A reversing trade is accomplished by assuming a short position in the same BP futures contract with December delivery. The trader's net position is now zero. The clearinghouse recognizes this position, so the trader is absolved from any future trading requirements. A long trader can enter into a reversing trade instead of taking delivery of the pounds. A short trader can assume a reversing trade instead of delivering pounds.

Market Growth

The continuing integration of international capital markets and the increasing volume of international trade have resulted in an explosive growth of currency forward and futures trading. The currency forward market is substantially larger than the currency futures market when measuring market size by the U.S. dollar amount of underlying currency traded. Most estimates place the forward market at about twenty times larger. However, the currency futures market is growing more rapidly when measured in percentages. Figure 12.1 displays the growth in currency futures trading on the IMM. Over the 14-year period 1975 through 1989, contract volume increased over a hundredfold.

Market Regulation

Organized futures markets are regulated to ensure performance and to preclude illegal activities such as insider trading and price manipulation. U.S. futures markets, including those offering contracts on foreign exchange, are regulated by the Commodity Futures Trading Commission, which is federal agency empowered to approve new contracts, set maximum daily price limits, ensure the competency of brokers, and the like. Also, the National Futures Association was recently established as a type of self-regulatory agency. The London International Financial Futures Exchange, which is the second largest currency futures trading market, is regulated by the International Commodities Clearing House.

USING CURRENCY FORWARD AND FUTURES CONTRACTS

Investors and MNCs typically employ currency forward and futures contracts for one of the following three reasons: price discovery, speculation, or hedging exchange exposure. In this section we discuss each reason, providing illustrations throughout.

Price Discovery

Trading a currency forward or futures contract implies the receipt or delivery of the underlying foreign exchange at a specified rate of exchange. Such a rate is largely determined by investors' expectations about the spot rate of exchange at contract delivery. Consequently, a forward or futures price may serve as an indicator of future currency values.

Currency forward and futures prices are not perfect forecasts of actual future currency values, and most contend that forward and futures rates are biased estimators, although the magnitude of the bias appears to be small. Still, the usefulness of currency forward and futures prices for price discovery depends largely on the availability, cost, and accuracy of alternative forecasting techniques and services. Viewed in this context, currency forward and futures prices are relatively attractive estimators. They are readily available, inexpensive to obtain, and many empirical studies find that alternative estimators are not, on average, much more accurate (Levich 1983).

To exemplify the relative forecast accuracy of currency forward and futures prices, consider the results presented in Exhibit 12.7 on page

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1 However, see the discussion in Chapter 4 concerning the finding that the current spot rate may be a superior predictor of future rates than is the contemporaneous forward rate.
Futuresgate 1989

In January of 1989 the FBI disclosed a massive, ongoing investigation of abusive futures trading practices at both the Chicago Board of Trade (CBOT) and Chicago Mercantile Exchange (CME). The investigation centered on the Japanese yen and Swiss franc futures pits at the CME, and the U.S. Treasury bond and soybean futures pits at the CBOT. FBI agents posing as independent floor brokers and traders under assumed names, found several abusive practices, especially an illegal trading scheme known as bucket trading.

Bucket trading occurs when two traders compare to exploit profits on public market orders by delaying the order’s execution. Here is how a bucket trade can be executed:

- **First**, an independent floor broker receives a client’s market order, which is an order to execute a trade at the best currently available market price. For instance, suppose the order is to buy 25 Swiss franc futures contracts.
- **Second**, the floor broker signals a confederate, called a “bagman,” to buy the contracts. The bagman buys the 25 contracts at $875.50 per contract, or $21,887.50. The floor broker continues to hold the client’s market order.
- **Third**, suppose the price rises shortly to $875.70. The floor broker now executes the client’s order. The client believes that $875.70 was the best available price. The bagman sells the 25 contracts at $875.50 for a profit of $1.75. The profit, which should have been the client’s, is “bucketed” into the bagman’s account. The bagman and the broker later split the money. If the Swiss franc future price had fallen, the customer would have purchased the contracts from the bagman at the $875.50 price. Hence, the loss is bucketed into the client’s account and the two illegal traders do not exhibit any losses.

The FBI’s investigation is still unfolding. The federal government has issued dozens of subpoenas and is reportedly offering full immunity for cooperation into the investigation. Although it is too early to draw meaningful inferences, many feel that Futuresgate 1989 will lead to several operating changes, including more trading surveillance, more complicated trading and especially the banning of bucket trading. Such a ban would help to reduce or eliminate abusive practices like bucket trading. Notice that the bagman in preceding illustration must be a dual trader.

234, which provides percentage forecast errors for four exchange rate forecasting services and the simple currency forward rate obtained from the Wall Street Journal. Forecasts are for 30-day forward rates, nonoverlapping for the 5-year period 1985 through 1989. The forward rate has a lower average percentage forecast error than any of the more expensive forecasting services. With the two exceptions of Harris Bank’s $CD forecast and Chemical Bank’s $JY forecast, the forward rate exhibits smaller forecast errors. Arguably, none of the average errors are statistically distinguishable.

Speculation

Currency futures contracts can be used to speculate on forecasted changes in rates of exchange. Consider a simple speculative trade involving British pound futures. Suppose that the current spot rate is $1.8300/E., and that the futures price for December delivery is $1.8250/E. (see Exhibit 12.4). If a position trader believes that the pound will depreciate to the degree implied by the futures price, he will buy the futures contract and subsequently undertake a reversing trade to close his long position. To gain, the speculator must be able to reverse at a new futures price for December delivery, of $1.8238/E. or higher.

Figure 12.2, on page 236, presents a contingency graph summarizing the strategy. If the position trader is correct and the subsequent futures

<table>
<thead>
<tr>
<th>Price</th>
<th>Percentage Forecast Errors</th>
</tr>
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<tbody>
<tr>
<td>$1.8300/E.</td>
<td>1.8%</td>
</tr>
<tr>
<td>$1.8250/E.</td>
<td>2.5%</td>
</tr>
<tr>
<td>$1.8250/E.</td>
<td>4.5%</td>
</tr>
<tr>
<td>$1.8250/E.</td>
<td>10.0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exchange Rates</th>
<th>Average Error</th>
</tr>
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<tbody>
<tr>
<td>$CD</td>
<td>$DM</td>
</tr>
<tr>
<td>Chemical Bank</td>
<td>0.2%</td>
</tr>
<tr>
<td>Citibank</td>
<td>0.5%</td>
</tr>
<tr>
<td>Home Bank</td>
<td>1.7%</td>
</tr>
<tr>
<td>Security Pacific</td>
<td>1.2%</td>
</tr>
<tr>
<td>Forward Rate</td>
<td>1.9%</td>
</tr>
</tbody>
</table>

price is, say, $1.8300/E., then his proceeds are $0.0062/E., or $875.50 per contract ($1.8300 — $1.8238) × 62,500 pounds per contract. Of course, these proceeds must be sufficient to cover the trader’s transaction costs. These costs are nominal for locals, but can be important for public speculators. The round-trip brokerage fee for public futures traders is currently about $30.00 per contract at discount brokerage firms.

Speculative strategies can be more elaborate than the one just described. Consider an intracurrency spread, which involves the purchase and sale of futures contracts on the same underlying currency but with two different delivery dates. Suppose you observe the following rates (see Exhibit 12.4):

<table>
<thead>
<tr>
<th>$</th>
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<tbody>
<tr>
<td>1.8301</td>
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<tr>
<td>1.8250</td>
</tr>
<tr>
<td>1.8150</td>
</tr>
</tbody>
</table>

Also suppose that you believe the pound will depreciate by more than implied by these futures prices. You could short the deferred contract (March 1989), but a spread is less risky. To establish the intracurrency spread, you short the deferred contract at $1.8150, and take a long position in the nearby contract (December 1988) at $1.8238. To profit, you must be able to reverse these trades, before the December expiration, such that the price difference between the new December and March futures is $0.0088 or greater. For instance, suppose that you reverse at the following futures prices: $1.8200 for the December contract and $1.8000 for the March 1989 contract. The pound has depreciated, consistent with your forecast; also, the resulting price difference, $0.0200 = $1.8200 — $1.8000, is greater than the original difference, $0.0088 = $1.8238 — $1.8150, so you profit. Here your profit is $0.0112/E., or $700.00 per contract ($0.0200 — $0.0088) × 62,500] ignoring transaction costs and taxes. Figure 12.3, on page 237, provides a contingency graph for this intracurrency spread.
Another more elaborate speculative trading strategy is the intercurrency spread, which involves the purchase and sale of futures contracts with the same delivery dates but with two different underlying currencies. Suppose a position trader observed the following rates (see Exhibit 2.4):

<table>
<thead>
<tr>
<th></th>
<th>$/£</th>
<th>$/CD</th>
<th>Cross Rate (£/CD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spot</td>
<td>1.8301</td>
<td>0.8195</td>
<td>0.4462</td>
</tr>
<tr>
<td>December Futures</td>
<td>1.8238</td>
<td>0.8115</td>
<td>0.4450</td>
</tr>
</tbody>
</table>

The cross rates (£/CD) are generated by dividing $/CD by $/£. These cross rates represent prices implied by the $/£ and $/CD rates.

Now suppose the position trader feels that the CD will depreciate relative to the BP, by less than that implied by the December futures cross rate, £0.4450/CD. For instance, the speculator may feel that the CD will actually appreciate against the BP during the period. She can try to profit from this forecast through an intercurrency spread. Specifically, she will write the December pound futures and buy the December CD futures. She must be careful to match the position sizes such that the numbers of BP and CD are equal. If she can reverse these trades such that the futures price difference is less than $1.0123 ($1.8238/BP – $0.8115/CD), then profits (ignoring taxes and transaction costs) are realized. For example, suppose that she can reverse at the following futures prices: $1.8238 for the December pound contract, and $0.8150 for the December CD contract. The CD has appreciated against the BP, consistent with her forecast (the new December futures cross rate is £0.4469/CD); also, the resulting price difference is $1.0088 = $1.8238 – $0.8150, which is less than $1.0123, so she profits. Here the position trader's profit is $0.0035 per unit of foreign currency. Figure 12.4 provides a contingency graph for this intercurrency spread.

Hedging Exchange Exposure

Although currency forward and futures contracts can be used for price discovery and speculation, the primary reason for their existence is to facilitate the hedging of exchange rate risk. By providing an efficient means of risk transfer, currency forward and futures markets contribute to social welfare. They serve as insurance markets, allowing participants to reduce the disutility associated with price and revenue variability attributable to unexpected exchange rate movements. This in turn enhances stability and promotes international trade. Moreover, the existence of these contracts can be argued to contribute to market completion, in the Arrow-Debreu sense.

1 In this subsection we assume that the goal of hedging is to minimize variability attributable to exchange rate movements. The minimum variance hedge ratio for foreign exchange is assumed to be β₀, meaning that a one-to-one correspondence between the number of foreign currency units in the spot and futures markets will minimize the hedger's exchange exposure. See Appendix 12.A for a discussion of these assumptions.
A Winning Speculative Strategy with Currency Futures?

Thomas (1986) analyzed the following speculative trading strategy involving currency futures: in each period, futures on discount currencies were purchased, and futures on premium currencies were sold. The currency futures price was, on average, an unbiased estimator of the future spot exchange rate at contract settlement. Thomas' strategy would yield zero profits on average, however, since his speculative strategy did not depreciate on average to the degree implied by the futures price, and since premium currencies did not appreciate to the degree implied during Thomas' sample period. Alternatively, his results suggest that the futures price is not an unbiased predictor of the actual future spot rate. As we shall see in Chapter 13, the currency futures price may not be unbiased if interest rates are nonconstant, or if savers are not risk-neutral, or if both conditions occur.

A Long Hedge For our first hedging illustration, assume that a U.S. auto dealer contracts on February 1 to take delivery of ten Mercedes, at DMI100,000 each, on May 15. The importer must pay DMI1,000,000 on delivery, and wishes to immunize against an unexpected appreciation in the mark relative to the U.S. dollar. The current $/DM spot rate is $0.5780.

Since marks will be paid in May, the U.S. auto dealer uses the June DM futures contract. Assume that this contract is currently priced at $0.5950/DM (see Exhibit 12.4). At 125,000 marks per contract, the price of one contract is $74,375 ($0.5950 × 125,000). The importer wants to hedge marks currently worth $578,000 ($1,000,000 × 0.5780) with contracts priced at $74,375 each. Thus, the number of contracts is 7.8 ($578,000/74,375). The dealer decides to take a long position in eight DM futures contracts with June delivery.

Suppose that on May 15 the $/DM spot rate is $0.6000. Consequently, the mark appreciated and the auto dealer must pay more for the Mercedes: $0.6000/DM × DMI1,000,000 = $600,000. Fortunately, however, the mark futures price increased to $0.6189/DM, or $77,362.50 per contract (assumed). For eight contracts the dealer’s profit is $23,900 (8 × ($77,362.50 − 74,375.00)). Thus, the long futures position covered all of the Mercedes’ additional cost ($600,000 − 578,000 = $22,000) due to the mark’s increased value. Also, the importer realized a profit of $1,900 ($23,900 − 22,000) on the entire transaction.

The degree of losses due to the mark’s appreciation that is covered by the long futures position depends on the subsequent spot and futures rates on May 15. However, as long as the spot and futures rates move in the same direction, the hedge will succeed in reducing at least part of the dealer’s loss on the Mercedes import. If the mark depreciated over the period, there would have been a loss on the futures position that would have offset some or all of the gain on the Mercedes import.

| February 1 | Spot rate is $0.5780/DM. |
| Cost of ten Mercedes is $578,000. |
| June DM futures price is $0.5950. |
| Buy (long) eight June DM futures contracts. |
| May 15 | Spot rate is $0.6000/DM. |
| Cost of ten Mercedes is $600,000. |
| June DM futures price is $0.6189. Enter a reversing trade (sell eight contracts). |
| Results: Profit on Mercedes import is $−22,000. Profit on futures transaction is $23,900. Net profit is $1,900. |

A Short Hedge For our second illustration of hedging exchange exposure, assume that a U.S. corporation has a U.K. subsidiary that is expected to generate earnings of £1,020,000 at the end of the operating quarter, March 31. The U.S. firm wishes to repatriate the pounds, perhaps to pay domestic shareholders a quarterly dividend. Let the current spot rate (January 20) be $1.8301/£. The current April BP futures price is $1.8010. The U.S. firm would like to hedge against an unexpected depreciation in the pound, since such a depreciation will result in fewer U.S. dollars upon repatriation. The firm can do so by shorting BP futures contracts for April delivery.

Since there are 62,500 per futures contract traded on the IMM, each contract’s price is currently $112,562.50 ($1.8010 × 62,500). The firm wants to hedge pounds currently worth $1,866,702 ($1.8301 × 1,020,000) with contracts priced at $112,562.50 each. The number of contracts is therefore 16.6 ($1,866,702/112,562.50). The firm decides to take a short position in 16 June BP futures contracts.

Suppose that on March 31 the $/£ spot rate is $1.7500. The pound depreciated and the U.S. firm receives fewer dollars upon repatriation.
$1,785,000 = $1.7500/E × £1,020,000. Fortunately, however, the BP futures price decreased to $1.7250, or $107,812.50 per contract (assumed). The U.S. firm can enter a reversing trade, realizing a profit on the sixteen contracts of $76,000 (= 16 × ($107,812.50 – 112,562.50)). Consequently, the short futures position covered most of the loss on the spot position (= $81,702 = 1,785,000 – 1,866,702) due to the pound’s decreased value.

<table>
<thead>
<tr>
<th>January 30:</th>
<th>Spot rate is $1.9530/E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anticipate repatriating $1,020,000 on March 31.</td>
<td></td>
</tr>
<tr>
<td>April BP futures price is $1.9010</td>
<td></td>
</tr>
<tr>
<td>Short 16 April BP futures contracts.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>March 31:</th>
<th>Spot rate is $1.7950/E</th>
</tr>
</thead>
<tbody>
<tr>
<td>April BP futures price is $1.7250</td>
<td></td>
</tr>
<tr>
<td>Enter a reversing trade (buy 16 contracts).</td>
<td></td>
</tr>
</tbody>
</table>

**Results:**

- Profit on repatriation is $81,702
- Profit on futures transaction is $76,000
- Net profit is $5,702

### SUMMARY

A currency forward or futures contract obligates a trader to buy or sell an underlying currency in the future at a specified rate of exchange. Forward contracts are tailored to the specific needs of customers, and futures contracts are standardized and traded in pits located on the trading floors of organized futures exchanges. Some of the differences between these contracts and markets were detailed in Exhibit 12.3. An especially noteworthy difference concerns daily resettlement in the currency futures market. Daily resettlement is a procedure that requires futures traders to realize losses each day. This process allows traders to post a small fraction of the underlying currency’s value (the margin) in order to contract. The resettlement procedure also creates a safer futures market, allowing smaller customers to transact.

Although currency forward and futures contracts can be used for price discovery and speculation, their major purpose is to facilitate the hedging of exchange rate risk. Investors and MNCs can employ these contracts to help immunize against exchange exposure.

Volume and open interest in these contracts has been growing rapidly over the last decade. In the next chapter we examine the determination of currency forward and futures prices, and examine extant empirical evidence concerning these markets.

### Questions and Problems

1. How do currency forward and futures contracts differ with respect to the following: maturity; settlement; cash flows?
2. What is the primary role of a clearinghouse?

### 12. CURRENCY FORWARD AND FUTURES MARKETS

3. What agencies regulate U.S. futures trading?
4. What is maintenance margin? A variation margin?
5. Why are initial margins so low?
6. Exhibit 12.5 reports that initial margins vary by currency. Why do you suppose this occurs?
7. From Exhibit 12.4, what was the settlement price for Swiss francs with June 1989 delivery? What was the settlement price for the nearby contract?
8. What are the three purposes of currency forward and futures markets? What is the major social welfare provided by these markets?
9. Suppose that a currency speculator believes that the German central bank will soon begin expanding its money supply rapidly in an attempt to stimulate its economy. What can this speculator do to exploit this belief?
10. Assume that it is now November and a U.S. importer has agreed to purchase 100,000 bottles per month of a fine French wine for three months beginning in January. The U.S. importer has agreed to pay the French exporter 88 francs per bottle. Also, the U.S. importer has contracted to distribute the 300,000 bottles to various interests for $16.50 per bottle. There is a $0.50 per bottle import duty, and shipping costs are $0.05 per bottle. There are no other costs. The importer has obtained the following $/FF forward rates:

<table>
<thead>
<tr>
<th>Month</th>
<th>Forward Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>$0.1252</td>
</tr>
<tr>
<td>February</td>
<td>$0.1247</td>
</tr>
<tr>
<td>March</td>
<td>$0.1241</td>
</tr>
</tbody>
</table>

If the importer is fully hedged, how much profit does he earn?

11. On September 11 a U.S. based MNC with a German subsidiary decides to transfer DM3,000,000 from an account in Stuttgart to an account at a New York bank. The currency spot rate is $0.5950/DM. The transfer cannot occur until December 10, and the current DM futures price for December delivery is $0.6075/DM. How many futures contracts should the U.S. MNC short in order to hedge? What is the MNC’s net profit on December 10 if the new spot rate is $0.5907/DM and the reversing trade occurs at a new futures price of $0.6012/DM?

12. Assume that a position trader forecasts an appreciation of the German mark relative to the dollar. To profit, the trader undertakes the following intracurrency spread: long the June DM futures contract at $0.5490/DM, and short the March DM futures contract at $0.5450/DM. Suppose that in mid-March the trader lifts the spread by engaging in reversing trades at the new futures prices of $0.5353/DM (March) and $0.5625/DM (June). What is the position trader’s profit per mark, ignoring taxes and transaction costs?

13. Using the price information contained in Exhibit 12.4, create an intercurrency spread for a forecasted increase in the short-term pound-mark cross rate. Provide a contingency graph for your spread position.
Appendix 12.A

THE MINIMUM VARIANCE HEDGE RATIO FOR FOREIGN EXCHANGE

The objective of hedging often is to obtain the lowest level of risk. Define the profit from a short currency hedge as

\[ \pi = \Delta S + \Delta F N_t, \]

where \( \pi \) is profit, \( \Delta S \) is the change in the spot rate, \( \Delta F \) is the change in the forward/futures price, and \( N_t \) is the number of forward/futures contracts.

The variance of the profit is

\[ \sigma^2_{\pi} = \sigma^2_{\Delta S} + \sigma^2_{\Delta F} N_t^2 + 2 \sigma_{\Delta S \Delta F} N_t, \]

where \( \sigma^2_{\pi} \) is the variance of the hedged profit, \( \sigma^2_{\Delta S} \) is the variance of the change in the spot rate, \( \sigma^2_{\Delta F} \) is the variance of the change in the forward/futures rate, and \( \sigma_{\Delta S \Delta F} \) is the covariance of the change in the spot rate and the change in the forward/futures rate.

Our objective is to determine \( N_t \) such that \( \sigma^2_{\pi} \) is minimized. Differentiating \( \sigma^2_{\pi} \) with respect to \( N_t \) gives

\[ \frac{d \sigma^2_{\pi}}{d N_t} = -2 \sigma_{\Delta S \Delta F} N_t + 2 \sigma^2_{\Delta F}, \]

Setting eq. 12.A.3 equal to zero and solving for \( N_t \) gives

\[ N_t = -\sigma_{\Delta S \Delta F} / \sigma^2_{\Delta F}. \]

A check of the second derivative confirms that this is a minimum. The negative sign implies that the hedger should sell currency forward/futures. The sign should have been positive if we formulated the problem as a long currency hedge.

The effectiveness of the minimum variance hedge ratio is determined by examining the amount of exchange rate risk reduced. Define \( h \) as the percentage of unhedged risk that the short currency hedge eliminates:

\[ h = (\sigma^2_{\Delta S} - \sigma^2_{\pi}) / \sigma^2_{\Delta S}. \]


\[ h = (N_t \sigma^2_{\Delta S}) / \sigma^2_{\Delta S}. \]

Equation 12.A.6 is the coefficient of determination from a regression relating currency forward/futures prices and currency spot rates. If the coefficient of determination is one, indicating perfect positive correlation between spot and forward/futures rates, then, from eq. 12.A.5, \( \sigma^2_{\pi} = 0 \), and from eq. 12.A.4, \( N_t = -1 \) since \( \sigma_{\Delta S \Delta F} = \sigma^2_{\Delta F} \). Thus, the minimum variance hedge ratio is simply \(-1\) (or \( +1 \) for a long currency hedge) if spot and forward/futures rates are perfectly positively correlated. This can be confirmed by using eq. 12.A.2 and recognizing that \( \sigma^2_{\Delta S} = \sigma^2_{\Delta F} \) when \( h \leq 1 \).
It can also be shown that $\sigma_{1s}^2 = \sigma_{1f}^2$ if interest rates are constant. Suppose that the instantaneous spot rate change relative is given by the following standard Itô process:

$$dS = \mu S dt + \sigma S d\tilde{Z},$$

where $\mu$ is the expected instantaneous spot rate change relative and $d\tilde{Z}$ is a standard Wiener process increment. Also, let the forward/futures rate by given by the interest rate parity theorem:

$$F = S e^{-r(T-t)},$$

where the U.S. ($r$) and foreign ($r_f$) rates of interest are assumed constant. From Itô's lemma:

$$dF = [(\partial F/\partial S)\mu S + (\partial F/\partial t) + (1/2)(\partial^2 F/\partial S^2)\sigma^2 S^2] dt + (\partial F/\partial S)\sigma S d\tilde{Z},$$

where $\partial F/\partial S = e^{-r(T-t)}$, $\partial F/\partial t = -(r-r_f)S e^{-r(T-t)}$, and $\partial^2 F/\partial S^2 = 0$. Substituting for the partial derivatives yields

$$dF = [e^{-r(T-t)}\mu S - (r-r_f)S e^{-r(T-t)}] dt + e^{-r(T-t)}\sigma S d\tilde{Z} = (\mu - r + r_f)F dt + \sigma F d\tilde{Z}.$$

Thus, the instantaneous volatilities of currency spot and forward/futures price changes are equal under constant rates of interest (compare eqs. 12.A.7 and 12.A.10). Under the notation used in deriving the minimum variance hedge ratio, $\sigma_{1s}^2 = \sigma_{1f}^2$. Finally, notice that the instantaneous drifts of spot and forward/futures rates differ by $r - r_f$. This result occurs since the spot and forward/futures rates converge at contract maturity.

The preceding proof demonstrates that $\sigma_{1s}^2 = \sigma_{1f}^2$ if interest rates are constant. Thus, it must be that $N_f = \pm 1$ when interest rates are constant and the interest rate parity theorem holds continuously. However, in reality interest rates are nonconstant, implying that currency spot and forward/futures rates may not be perfectly positively correlated and, thus, the minimum variance hedge ratio may not be $\pm 1$.

Empirically, we investigate the correlation structure between spot and forward/futures rates by regressor spot currency returns onto contemporaneous "returns" (percentage changes) on nearby futures contracts. The analysis uses closing prices for the first trading day of each week for futures contracts on British pounds, Deutsche marks, and Japanese yen traded on the IMM between January 1981 and June 1988. Spot exchange rates are obtained from 3:00 p.m. Eastern time quotes by Bankers Trust Company. The sample is divided into two subsets. The first, January 1981 through May 1985, reflects a strong U.S. dollar period; the second, June 1985 through June 1988, reflects a weak U.S. dollar period.

The correlation coefficients for each currency for both periods are reported in the following table. In all cases the correlation between returns on spot and futures, $\rho_{sf}$, is large, suggesting that a hedge ratio of $\pm 1$ is a reasonable ratio to employ in order to minimize return variance attributable to exchange rate fluctuations.

<table>
<thead>
<tr>
<th>Correlation Coefficients ($\rho_{sf}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Currency</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>British pound</td>
</tr>
<tr>
<td>Deutsche mark</td>
</tr>
<tr>
<td>Japanese yen</td>
</tr>
</tbody>
</table>